UNIVERSITY OF SASKATCHEWAN
ELECTRICAL ENGINEERING 455.3

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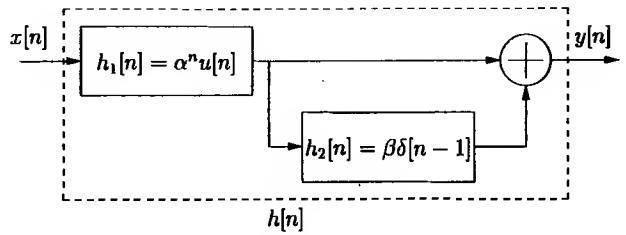
Assignment Quiz 5
November 5, 2001

Instructor: B.L. Daku
Time: 15 minutes
Aids: None

Name:
Student Number:

1. Given the following system, where $|\alpha| < 1$,



(a) Directly, find the impulse response $h[n]$ of the overall system. (Do not use the frequency response to find $h[n]$.)

(b) Is this system causal? Why or why not?

(c) Find the frequency response of the overall system.

(d) Specify a difference equation that relates the output $y[n]$ to the input $x[n]$.

a) $h_1[n] = \alpha^n u[n]$

$h_2[n] = \beta\delta[n-1]$

$h[n] = h_1[n] * (h_2[n] + 1)$

$= h_1[n] * h_2[n] + h_1[n]$

$= \sum \alpha^n u[n]\,\beta\delta[n-1] + \alpha^n u[n]$

$h[n] = \alpha^{n-1} u[n-1]\,\beta + \alpha^n u[n]$

$h[n] = \beta\alpha^{n-1} u[n-1] + \alpha^n u[n]$

$a^n u[n] = \frac{1}{1-ae^{-j\omega}}$

$\mathcal{F}\{u[n]\} = e^{j\omega}$

$\alpha^n u[n] = \frac{1}{1-\alpha}$

Zeros	Poles
$1+\frac{3}{2}=0$	$z=0$
$1=-\frac{3}{2}$	$1-\frac{1}{3z}=0$
$z=-3$	$1=\frac{1}{3z}$
$1+\frac{2}{z}=0$	$z=\frac{1}{3}$
$1=-\frac{2}{z}$	$1-\frac{2}{z}=0$
$z=-2$	$1=\frac{2}{z}$
	$z=2$
	$1-\frac{3}{z}=0$
	$1=\frac{3}{z}$
	$z=3$

b) when $n<0$ system is zero cause $h[n]$ is zero
yes system is causal ✓

c) $H(e^{j\omega}) = \left(\frac{\beta}{\alpha}\right)\left(\frac{1}{1-\alpha e^{-j\omega}}\right) + \left(\frac{1}{1-\alpha}\right)$

$= \frac{\beta}{\alpha - \alpha^2 e^{-j\omega}} + \frac{1}{1-\alpha}$ $= \frac{\beta - \alpha\beta + 1 - \alpha^2 e^{-j\omega}}{1+\beta e^{-j\omega}}$

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Instructor: B.L. Daku
Time: 10 minutes
Aids: None

Name:
Student Number:

1. Given the z-transform,

$$X(z) = \frac{z^{-1}(1+5z^{-1}+6z^{-2})}{(1-\frac{1}{3}z^{-1})(1-2z^{-1})(1-3z^{-1})}$$

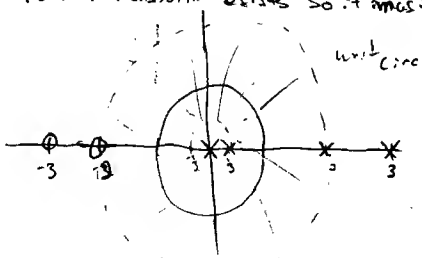
(a) Determine the ROC of $X(z)$ if it is known that the Fourier transform exists. For this case, determine whether the corresponding sequence $x[n]$ is right-sided, left-sided or two-sided?

(b) How many possible two-sided sequences does $X(z)$ have?

(c) Is it possible for $X(z)$ to be associated with a sequence that is both stable and causal? If so, give the appropriate ROC. If not, explain why not?

a) $X(z) = \frac{(1+5z^{-1}+6z^{-2})}{z(1-\frac{1}{3z})(1-\frac{2}{z})(1-\frac{3}{z})} = \frac{(1+\frac{5}{z})(1+\frac{2}{z})}{z(1-\frac{1}{3z})(1-\frac{2}{z})(1-\frac{3}{z})}$

Fourier transform exists so it must include unit circle



$\frac{1}{3} < |z| < 2$

b) 2 ✓
$\frac{1}{3} < |z| < 2$
$2 < |z| < 3$

c) No, for it to be stable it has the ROC must include the unit circle, and for it to be causal $|z| > 3$ in this case, so it cannot happen